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ABSTRACT

The curriculum outline is designed to aid the instructor in developing a more complete course of study and in presenting a more consistent drafting and design program for intermediate and secondary school students. The guide is introduced by a discussion of objectives fundamental to a sound program of industrial arts education, followed by an outline and objectives for the content area of the course. The content is presented with reference to four levels of instruction. It is divided into nine parts, each containing an outline, course content, suggested instructional levels, student and teacher activities, and units of instruction. The nine parts are: orientation to drafing; shape description--multiview projection; shape description--pictorials; size description; quantity and location description; graphic geometry; machine design; architectural; and specialty categories. Appendixes provide a bibliography, publishers' address list, lists of films and film sources, sources for occupational information, and a list of suggested drafting equipment. (NH)

ED 099475

INDUSTRIAL ARTS
DRAFTING AND DESIGN TECHNOLOGY

A CURRICULUM GUIDE
FOR
INTERMEDIATE AND SECONDARY LEVEL
PROGRAMS

U.S. DEPARTMENT OF HEALTH, EDUCATION & WELFARE
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ARTHUR MALLORY

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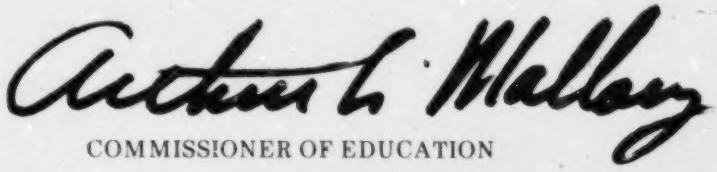
FOREWORD

This curriculum guide was formulated by a committee under the auspices of the Missouri Council for Industrial Arts Education. In preparing and publishing the curriculum guide, the appointed committee, cooperating with supervisory personnel of the State Department of Education, worked toward the goal of initiating and improving drafting and design instruction in Missouri.

The guide is designed to aid teachers in establishing course objectives and course content, as well as planning teaching methods and evaluation procedure. It is intended that the individuals and groups that review and use this publication will find the suggested content, activities and teaching aids presented in a manner that will enable the user to adopt or adapt them in a meaningful manner.

The background experiences of the members of the drafting and design committee included a variety of teaching experiences and educational qualifications so necessary in formulating a functional publication of this type. The donation of time and effort by committee members indicates the importance they place on drafting and design in industrial arts and in the overall education program. Special recognition also goes to the state and national professional industrial education organizations whose materials were reviewed.



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INTRODUCTION

The area of drafting and design of Industrial Arts education permeates every facet and branch of modern American industry.

Nothing is made in industry without first having a plan. The plan may be just a simple freehand sketch or a multipage, multiview working drawing complete with all symbols, notes, multiview details and specifications; or the plan may be something in between these two extremes. But in industry there is no production without a plan.

Today there is a need for engineers, technicians, skilled workers, sales and service people to know how to read and interpret working drawings, and teachers to teach the completion and use of these drawings. Even the general public, today's consumers, can benefit greatly from a knowledge of and the ability to use working drawings and pictorial assembly drawings.

The content of this curriculum guide suggests far more material than could probably be covered in most modern Industrial Arts programs. However, the curriculum guide is designed to aid the instructor in developing a more complete course of study and in presenting a more consistant drafting and design program for intermediate and secondary school students of Missouri. Each teacher using this guide should make adaptations to meet his teaching conditions and classroom facilities.

POINT OF VIEW AND OBJECTIVES

A principal purpose of American education is to assist each individual in his development as a productive member of society. The achievement of this purpose enables him to provide for his basic needs, to produce more than he consumes, and to contribute more than he receives. It also involves the development of ideals and goals, the acceptance of social responsibility, and the acquisition of desirable character traits.

Behavorial changes within the individual are effected through experiences and the interpretation of these experiences. The experiences provided by the school permit one to acquire the skills and knowledges which allow the individual to develop to his maximum potential with profit to himself and society. The learner's interpretation of these educational experiences provide for the further development of desirable character traits which lead to the wise application of the acquired skills and knowledges.

Industrial arts contributes to the purpose of American education by aiding individuals as they gain an understanding of their industrial-technological environment. In order that each individual may understand and learn to exercise some control over this environment, experiences in industrial arts must be an integral part of the overall educational program for all students, both boys and girls, and should be available at all grade levels. The importance of this experience is recognized in Missouri where credit in the practical arts, which includes industrial arts, is a secondary school graduation requirement.

Industrial arts education provides an opportunity for individuals to participate in direct experiences involving industrial skills and processes which foster an awareness of industry in American culture. These experiences are concrete, meaningful, and educational as they aid the individual in understanding abstract ideas. These experiences provide opportunity for an individual to apply mathematics, science, art, language arts, and other school subjects in purposeful situations.

Through the application of grouping and special instructional techniques, industrial arts in the secondary school can be organized to meet the needs of students of varying abilities. Individuals expecting to enter professional occupations as well as future industrial workers should benefit from industrial arts experiences. The need for industrial arts instruction has little relationship to the economic status of the student. Every person must be aware of and familiar with the concepts taught in industrial arts education if he is to live effectively in our industrial society.

Industrial arts education aids in the discovery and development of personal interests, aptitudes, creative thinking and technical abilities. Responsible and resourceful actions and judgements are matured through problem solving and self-expression in an environment related to industry. The future scientist or engineer may learn to solve technical problems, and the future technician or craftsman may devlop skills and related understandings in industrial arts courses.

Realistic objectives, clearly stated, are essential to a sound program of industrial arts education. The following statements of purpose are fundamental to quality industrial arts education as it provides opportunities for students to:

Develop an insight and understanding of tools, machines, materials, and processes as they relate to the production and servicing aspects of industry.

The field of industrial arts education is concerned with the study of materials and processes of industry and the creative use of design. Students of industrial arts education have an opportunity to gain a better understanding of mass production, automation, and other industrial methods if they actively participate in meaningful experiences dealing with the manufacturing of consumer goods, utilization and generation of energy as well as the servicing, testing, and repairing of industrial products.

Discover and develop abilities, aptitudes, and interests related to the technical pursuits and applied sciences.

Opportunities for students to have experiences which assist in the discovery of abilities and to develop their potentialities to the fullest is essential to the basic education of all youth. Allowance for differences of abilities, interests, and needs should be incorporated into the curriculum offerings so the student can better assess his abilities and interests for making an occupational choice, understanding his environment, and preparing himself to meet the changing demands of a technological society.

Develop basic skills in the safe and proper use of industrial materials, tools, machines, and processes.

Students are provided with experiences which help them develop basic skills relevant to industrial production; and servicing through these experiences, students gain a basis for making occupational choices. In addition, the skills provide a basis for a specialized occupational preparation. Many workers of the future will be required to train and retrain for different occupations during their lifetime. Fundamental skills and knowledge in diversified areas is most essential if this retraining is to be accomplished in an efficient manner.

Develop problem-solving and creative abilities relating to the tools, machines, materials, processes, and products of industry.

The industrial arts education program provides opportunities for solving various types of technical problems through experimentation and research as well as project planning and construction. The industrial arts laboratory setting provides an environment which makes possible a concrete, understandable approach to teaching problem-solving and critical thinking. Problem-solving in industrial arts education involves creative thinking and provides experiences which allow students to find solutions to problems and to evaluate the effectiveness of these solutions.

*Taken from the *Handbook for Industrial Arts Education*, Missouri State Department of Education, 1969.

Legislative Consideration

The definition of vocational education in Federal legislation was supplemented to include industrial arts education in 1973. The Federal Register, Vol. 38 No. 244-Wednesday, Nov. 21, 1973, carries the rules and regulations for this legislation. More specifically these rules and regulations indicate that industrial arts educational programs shall be designed to:

"(i) Assist individuals in making of informed and meaningful occupational choices.

(ii) Prepare individuals for enrollment in advanced or highly skilled vocational and technical educational programs."

Both of these objectives are included in the previously stated objectives quoted from the *Handbook for Industrial Arts Education*.

DRAFTING AND DESIGN TECHNOLOGY

This curriculum guide attempts to present a plan which suggests the scope and sequence of experience for the drafting area which is in keeping with the overall philosophy and objectives of industrial arts for Missouri as stated in the *Handbook For Industrial Arts Education*, State of Missouri. The plan is considered to be educationally sound and should be useful for all secondary school industrial arts drafting programs, whether they be in large multi-teacher departments or small single teacher programs. The following sections attempt to present the basic philosophy and objectives which underlie the suggested organization and content areas of this curriculum guide.

Students in drafting should have opportunities to participate in exploratory experiences which would foster an understanding of the role and scope of drafting in our industrial society. They should also develop basic drafting skills, acquire technical knowledge associated with the drafting area, develop attitudes appropriate for interaction in our society, and receive guidance information that will help to provide a realistic basis for occupational choice and specialized occupational preparation. Drafting at all levels should aid the student in the discovery and development of personal interests, special aptitudes, creative thinking, and technical abilities.

Considering the foregoing as the basic or overall goals, industrial arts drafting can serve the general education needs of all students, as well as the specialized needs and interests of some. This implies that at the introductory levels drafting should be basic and exploratory with emphasis upon the interpretation of the role of drafting in a technical society and upon its practical applications to everyday life. Thus drafting becomes a tool or a vehicle to the conceptual learning of how things are designed and produced and to the further understanding of industrial technology or other broadly explored associated concepts.

In addition, some levels or offerings in drafting need to be more technical or sophisticated in terms of the basic science involved--the science of drafting--covering the skills and knowledge required to depict the graphic size and shape description of three-dimensional objects. This emphasis will be found at the upper or advanced levels of drafting in the secondary school.

OBJECTIVES OF DRAFTING AND DESIGN TECHNOLOGY

With the overall goal of meeting the needs of the individual in his society, the objectives of drafting as a part of industrial arts may be categorized under the broad headings of KNOWING (cognitive domain--facts, concepts, applications, etc.); DOING (psychomotor domain--skills, work habits, etc.); and BEING (affective domain--attitude, character, etc.). In order to evaluate the effectiveness of instruction in achieving these objectives, one must observe desirable changes in the student in terms of the knowledge acquired, the skills developed, and the attitudes displayed. Listed below are the general objectives for industrial arts drafting. A further breakdown of specific objectives is given under the "Levels of Drafting" section.

Through the experiences in industrial arts drafting each student should:

KNOWING (cognitive domain--facts, concepts, applications, etc.)

1. Understand the role drafting plays in our industrialized society.
2. Know the principles and procedures utilized in communicating the solution to problems through drafting.
3. Be familiar with the career structure within the drafting profession.
4. Define and use correctly the technical terminology related to drafting.
5. Know the techniques for proper use of basic drafting equipment and media.

DOING (psychomotor domain--skills, work habits, etc.)

6. Interpret sketches and working drawings.
7. Make freehand sketches.
8. Make reproducible instrument drawings
9. Acquire the habit of an orderly and efficient performance of the drawing tasks.
10. Apply the process of problem-solving to drafting tasks.
11. Discriminate among industrial products in terms of their design characteristics.
12. Utilize empirical data found in tables, handbooks, and standards manuals in the graphic solution of problems.
13. Relate the concepts of mathematics and science and the principles of artistic design to the graphic solution of problems.

BEING (affective domain--attitude, character, etc.)

14. Assess his abilities, aptitudes, interests, and values as they relate to drafting careers.
15. Develop an attitude of personal achievement in accomplishing a task to the best of one's ability.
16. Develop the habit of self-reliance and resourcefulness in meeting practical drafting situations.
17. Develop the ability and desire to cooperate and work with others in pursuing common goals.
18. Be aware of the importance of good health and safe working conditions in the working environment.

DRAFTING AND DESIGN TECHNOLOGY
LEVEL I - EXPLORATORY

This is the recommended basic or beginning level for industrial arts activities in most schools and usually encompasses grades six, seven, eight, and nine. At this level, drafting experiences are a part of basic exploratory industrial arts offerings and normally should not be taught as a separate content. These experiences should be approached from the standpoint of their usefulness as a tool involved in the total experiences of this level. Hence, little formal drafting would be done aside from that which may be needed in the understanding and development of exploratory activities of the course.

As a result of activites involved in Level I drafting, each student should be able to:

1. Relate the "language of industry" to the construction and manufacturing of objects by making simple, but descriptive, sketches or drawings of objects.

2. Read and interpret with accuracy the basic size and location dimensions as shown on drawings of objects.

3. Describe the relationship of a draftsman and a drafting department to the total organizational structure of a manufacturing or construction industry.

4. Explain the types of work a draftsman may do and identify industries in which draftsmen may be employed.

5. Assess his personal assets and liabilities related to those required in drafting occupations.

BASIC DRAFTING TECHNOLOGY
LEVEL II

Following the Level I experience and usually beginning around grade nine or ten, the Level II drafting experiences are built upon the exploratory and basic experiences provided at Level I. The term "General Drafting" is often used to describe this level, thus indicating a broad and basic approach to the field.

Level II industrial arts courses are generally considered to be elective courses. Although usually offered as a single course, drafting at this level should serve the varied needs, interests, and abilities of students who wish to enroll.

Major emphasis at this level should be placed on the basic principles, skills, and terminology of drafting. Opportunities for exploratory experiences in many of the specialty areas or fields of drafting should be provided.

As a result of experiences at this level, students should be able to:

1. Make accurate technical sketches which represent the solution to basic drafting problems or the graphic delineation of original ideas or thoughts.

2. Make reproducible working drawings which depict the solution to basic problems.

3. Apply basic drafting principles and demonstrate an understanding of technical terminology related to the various specialty areas of drafting.

4. Identify and describe the career opportunities within the specialty areas of drafting; including pre-service and in-service preparation opportunities, entry and advancement opportunities and requirements, working conditions, and life style of persons employed in drafting positions.

5. Identify and evaluate personal aptitudes, interests, values, and abilities as they relate to occupations in drafting.

ADVANCED DRAFTING TECHNOLOGY
LEVEL III

Level III drafting courses are advanced offerings which are built upon and should be preceded by the Level II drafting experiences. In addition to serving as an extension or continuation of competencies developed at Level II, courses at this level should provide in-depth experiences in a rather specialized phase or area of drafting such as machine drafting, architectural drafting, or electronic drafting. Since the primary purpose of this level is to meet the more unique interests and needs of the individual, it may be necessary for some schools which have limited enrollment at this level to provide for a selection of specialized drafting experiences in a single course.

As a result of experiences in drafting at this level, students should:

1. Be able to demonstrate proficiency in the use of drafting equipment and media used in a specialized drafting field to the extent of producing neat, accurate, and reproducible drawings which represent solutions to problems encountered in that area.

2. Apply the concepts of skill, accuracy, and systematic planning related to the drafting area.

3. Improve or increase his knowledge of the technical content associated with the specialized areas of drafting.

4. Become aware of the need for continued improvement and development of the individual for advancement.

5. Improve problem solving and creative abilities.

6. Increase his knowledge of the occupational information related to drafting.

7. Continue to evaluate his personal characteristics and aspirations as they relate to probable success in drafting occupations.

SPECIALIZED DRAFTING AND DESIGN TECHNOLOGY
LEVEL IV

Since the role of industrial arts at this level is to meet the specialized needs of youth, a specific standardized drafting program cannot be prescribed that would be equally relevant and appropriate in all senior high schools. In general, emphasis should be placed on the development of additional specific drafting skills and techniques where necessary and upon the technical knowledge associated with the respective areas.

Research and development activities or the development of creative and problem solving abilities should receive major attention at this level. Familiarization with occupational requirements, procedures, practices, standards, etc. would be of much significance to students whose occupational interests are related to drafting.

In addition to occupationally oriented drafting courses, offerings at this level may also serve as extended study for students with special interests and be directed to the needs of groups representing cross disciplines within the school. Students interested in design, commercial art, or graphic arts layout may find interest in a course related to graphic design. Potential engineers or mechanical designers may wish to study engineering graphics topics in kinematics, nomography, or computer plotting as well as jig and fixture design or tool and die design. Potential architects, interior designers, or landscape planners may profit from activities related to home planning and furnishing. Construction enthusiasts may wish to work with architectural models or surveying techniques. Students who have original ideas for designs may learn to graphically portray their originality while they complete models or prototypes. Student behavioral objectives at this level will vary with the type of courses offered.

DRAFTING AND DESIGN TECHNOLOGY

This curriculum guide and the material relating to drafting and design is intended for use as a guide by teachers and administrators preparing Industrial Arts Curriculums on the junior high and senior high school levels. In many cases this will be the student's first formal opportunity for experiences in this area. It is important, therefore, that these experiences be such that his interest is awakened and his curiosity aroused, and that he be given an opportunity to gain basic knowledge of drafting techniques that are to serve him in any relation he may have in the future in either life generally, or specifically in drafting courses.

While some degree of uniformity in Industrial Arts programs is desirable, it is recognized that this may not always be possible. This guide is therefore prepared with a certain amount of flexibility in mind. Instructors may achieve this flexibility by varying the emphasis placed on certain units of instruction and by varying the degree and kinds of student experiences in these units. Instructors desiring greater emphasis in one area of drafting and design than in another will find sufficient material in this guide to meet their needs.

While sequence of instruction units and course content is often a matter of individual preference, it is felt that this guide is so arranged as to enable the instructor to direct the student activities in a meaningful and logical manner. The experiences are arranged to show the suggested levels each can introduce to allow for progression from the more elementary to the advanced activities, with each element of learning laying a foundation of knowledge for each succeeding element of learning.

DRAFTING AND DESIGN TECHNOLOGY

PART I - ORIENTATION TO DRAFTING

A. The Drafting Language
   1. Purpose of Drafting
   2. Standard Drafting Symbols

B. Career Opportunities and Requirements
   1. Job Titles
   2. Job Duties
   3. Profession Preparation and Development

C. Materials and Equipment
   1. Drafting Instruments
      a. Use & Care of Instruments
      b. Pencils (Grades, points & pointers)
      c. Erasers & Shields
      d. Scales
      e. Straight Edges
      f. Dividers & Compasses
      g. Inking Equipment
   2. Drafting Media
      a. Kinds
      b. Sizes
   3. Drafting Machines
      a. Kinds
      b. Sizes

D. Specifications and Standards
   1. Types of Standards Manuals
   2. Applications for the American National Standard Institute Drafting Manual
   3. Uses of Machinery's Handbook

E. Design Process
   1. Steps in Design Analysis Process
      a. Sources of Information for Researching a Design Problem
      b. Problem Solution
   2. Elements of Design
      a. Principles of Design Element Arrangement
      b. Functional Requirements
   3. Requirements in Securing Patents

F. Sketching
   1. Applications of Freehand Sketching
   2. Sketch Materials
   3. Proportion in Sketching
   4. Orthographic Sketching Techniques
   5. Pictorial Sketching Techniques

G. Lettering
   1. Importance of Good Lettering
   2. Forming Upper and Lower Case Letters
      a. Proportion of Integers and Fractions
   3. Spacing Letters and Words
   4. Origin of Alphabets and Letters
   5. Styles of Lettering
   6. Wording of Notes
   7. Titles, Parts Lists, and Revision Strip Contents
   8. Types of Mechanical Lettering Devices
   9. Types of Available Pre-printed Letters
   10. Types of Lettering Pens
   11. Microfilming Lettering Considerations

H. Drawing Reproductions
   1. Reasons for Drawing Reproductions
   2. Line Quality Considerations
   3. Folding, Filing & Storing Drawings
   4. Microfilm Aperature Cards

PART I - ORIENTATION TO DRAFTING

COURSE CONTENT	SUGGESTED LEVELS I	II	III	IV	STUDENT ACTIVITIES	TEACHING ACTIVITIES
A. SYMBOLS OF THE DRAFTING LANGUAGE						
1. Purpose of Drafting		x	x		Layout a drawing in metric values.	Discuss the purpose and place of drawings in American industries.
		x	x		Measure in metric values.	Explore with the class the concepts of communicating through drawings.
2. Standard Drafting Symbols	x	x			Interpret the alpahbet of lines.	Explain and show the standard symbols forming the universal language of drafting.
B. CAREER OPPORTUNITIES AND REQUIREMENTS						
1. Job Titles	x	x	x		Look at references for jobs titles of the drafting field.	Discuss duties, working conditions, and educational requirements for jobs of the drafting field.
2. Job Duties	x	x	x		Visit the Drafting facilities of a local industry.	Discuss the duties and procedures of special fields of drafting.
3. Professional Development			x		Study drawings of professional draftsmen. Note particularly the accuracy, skill, and neatness of the drawings.	Discuss the requirements of the draftsman for the professional dispatch of his duties relating to skill, knowledge, personal characteristics, and interests.
C. MATERIALS AND EQUIPMENT						
1. Drafting Instruments	x	x	x		Identify by name each tool needed and used in most drafting practices.	Display and discuss the instruments used in drafting.
	x	x	x			Demonstrate the proper use and care of each.

	x	x ½			Sharpen and point drawing pencils.	Display and discuss grades of drawing pencils, points and use.
	x	x			Use eraser and eraser shield to correct and clean drawings.	Discuss kind of erasers and demonstrate use of eraser shield.
	x	x			Measure and scale a drawing to some scale other than full scale.	Display and discuss the several scales used in drafting.
	x	x	x			Demonstrate how to scale a drawing for a given space.
	x	x	x		Draw vertical and horizontal lines with a T-square and triangle.	Demonstrate proper generation of lines with a triangle and T-square.
	x	x	x		Transfer dimensions from a scale to a drawing with dividers.	
	x	x	x		Generate circles with a compass.	
2. Drafting Media		x	x			Discuss and show the different media used for drawings and their qualities and sizes.
3. Drafting Machines		x	x		Measure and draw angles with the drafting machines.	Discuss and demonstrate the drafting machine verneer and the proper use and care of the machine, its adjustments and scales.
		x	x		Test squareness of machine's scales.	Adjust machine scale to be at a 90° angle.
D. SPECIFICATIONS AND STANDARDS						
1. Types of Standards Manuals	x	x	x		Use available standards to confirm a preferred procedure on lettering, sheet layout, and standard sheet size.	Discuss and show the different drafting room standards generally used today.
	x	x	x			Give the student a general orientation of standards manual contents.

COURSE CONTENT	SUGGESTED LEVELS I	II	III	IV	STUDENT ACTIVITIES	TEACHING ACTIVITIES
2. Applications of Manuals	x	x	x		Locate data from standards manuals for preference in showing dimensions of holes.	Review with students the use of standards manuals for specific references.
3. Machinery's Handbook		x	x		Locate data relating to screw thread tables.	Give the student a general orientation of machinery's handbook.
E. DESIGN PROCESS						
1. Design Analysis		x	x		Follow steps in a design analysis process to develop a functional object.	Introduce the student to the steps in the design analysis process so that the process can be applicable in any design procedure.
A. Sources of Design Data		x	x		Use data sources to research a design problem.	Discuss sources of data available in most drafting rooms.
B. Problem Solutions		x	x		Sketch multiple solutions.	Take the student through a design problem solution.
2. Elements of Design		x	x		Evaluate solution in terms of design requirements.	Discuss and enumerate the elemetns of good design.
3. Patent Requirements			x		Study several patent drawings--note technical differences from other drawings.	Discuss the requirements for securing a patent and the drawings needed.
F. SKETCHING						
1. Freehand Applications	x	x	x		Practice sketching vertical, horizontal, inclined lines and angles.	Discuss where and when sketching is of value to the draftsman and engineer.

					Practice sketching arcs and circles on drawings.	Show the studeat simple techniques of sketching arcs and circles.
2. Proportion in Sketching	x	x	x		Learn to sketch the basic geometric forms.	Discuss the importance of proportion in sketching.
3. Orthographic Sketching Techniques	x	x	x		Sketch an object keeping its parts to proper proportion.	Show the student how they may get proper proportions on basic geometric forms.
4. Pictorial Sketching Techniques	x	x	x		Sketch objects in isometric and oblique form.	Show student how isometric and oblique drawings can be sketched quickly.
G. LETTERING						
1. Importance of Good Lettering	x	x	x		Rule guide lines for letteing.	Discuss the importance of good lettering and how to develop the ability.
2. Forming Good Letters	x	x	x		Form Gothic letters, numerals and fractions.	Show how each letter is formed, proportioned and spaced.
3. Spacing Letters	x	x	x		Form letters and space them in words.	
4. Origin of Alphabets		x	x		Learn the names of the different parts of the letter.	Discuss the origin and development of modern alphabets.
5. Lettering Styles		x	x		Use letters to specify a c'bored hole.	Use examples to show the different styles and forms of letters.
6. Drawing Notes		x	x		Letter in the title block of a drawing.	Discuss the wording of drawing notes.

COURSE CONTENT	SUGGESTED LEVELS I	II	III	IV	STUDENT ACTIVITIES	TEACHING ACTIVITIES
7. Drawing Legend	x	x	x			Explain what information should be included in the title block.
	x	x	x			Show several title block examples.
	x	x	x		Develop a material list for a working drawing of multiple parts.	Discuss the need for a mateial or parts list for a multiple part working drawing. Explain what should be included in the list.
		x	x		Include a revision strip on a revised drawing.	Discuss the revision strip on drawings.
8. Lettering Devices			x		Use the mechanical letter devices available to develop ability with each.	Demonstrate the use of seveal mechanical letteing devices available to the students.
9. Pre-printed Letters		x	x		Practice placing and spacing pre-printed letters in words in confined spaces.	Show several types of pre-printed letters and demonstrate how each is used.
10. Lettering Pens		x	x		Use the several lettering pens available to develop ability with each.	Show several types and kinds of lettering pens used in graphics and drafting. Demonstrate effective use of each type pen.
11. Microfilm Lettering	x		x			Discuss the considerations that must be observed when drawngs are to be microfilmed.
H. DRAWING REPRODUCTIONS						
1. Reasons for Reproducing Drawings	x	x	x		Reproduce a machine drawing by methods available.	Discuss the several reproduction methods currently used to reproduce machine drawings.
2. Line Quality Considerations	x	x	x		Draw lines on drawings that will reproduce.	Discuss the line quality standards and sizes that enable quality reproduction.
3. Folding, Filing and Storing Drawings		x	x		Fold drawing as directed for storing.	Show the accepted ways of folding filing. and storing mechanical drawings.
4. Microfilm Aperature Cards			x		Make a film of a drawing affixed to an aperature card.	Discuss microfilm storage procedures and demonstrate procedure for microfilming.

PART II - SHAPE DESCRIPTION - MULTIVIEW

A. Principal View
   1. Theory of Orthographic View Relationships
      a. Planes of Orthographic Projection
      b. Space Principal Views of a Drawing

   2. Alphabet of Lines
      a. Width of Lines
      b. Precedence of Lines

   3. Selection of Necessary Views
      a. Concepts of Simplified Drafting
      b. Uses of Partical Views
      c. Uses of One View Drawings
      d. Uses of Two View Drawings
      e. Uses of Alternate Positions of Views
      f. Uses of Removed Views

   4. Classification of Surfaces and Lines
      a. Similarity of Surface Shapes in Views
      b. Law of Parallelism
      c. Principles for Determining Visibility of Views
      d. Principles of Reference Plans and Fold Lines

B. Sections and Conventions
   1. Section Views
      a. Uses of Section Views
      b. Principles of Visualizing a Section View
      c. Section Lining Symbols

   2. Conventions of Section Views
      a. Principles Involving Unnecessary Hidden Line Detail
      b. Methods of Showing Standard Parts in Section
      c. Uses of Alternate Section Lining

C. Auxiliary Views
   1. Definition of Auxiliary Views
   2. Reasons for Drawing Auxiliary Views
   3. Theory of Projecting and Transferring Measurement in Auxiliary Views

PART II - SHAPE DESCRIPTION - MULTIVIEW

COURSE CONTENT	SUGGESTED LEVELS I	II	III	IV	STUDENT ACTIVITIES	TEACHING ACTIVITIES
A. PRINCIPAL VIEWS	x	x	x		Identify the principal views of an object.	Discuss which are the principal view of an object and the orientation in the observation in of these views.
1. Orthographic Projection	x	x	x		Layout a multiview drawing.	
	x	x	x		Transfer measurements from view to view.	Discuss and demonstrate the planes of each view.
	x	x	x		Space view on a drawing.	Demonstrate the spacing of principal views.
	x	x	x		Align features of each view.	Indicate the importance of alignment of features for effective projection.
2. Alphabet of Lines	x	x	x		Apply alphabet of lines to all views.	Discuss the importance of line widths to the clarity of view understanding.
	x	x	x			Discuss the value of line precedence in the use of the alphabet of lines.
3. Selection of Necessary Views	x	x	x		Analyze and draw the principal views of an object.	Discuss the selection of views that best describe an object.
	x	x	x		Draw necessary views using simplified drawing technques.	Discuss and demonstrate concepts of simplified drafting.
		x	x		Use a partial view in conjunction with other views to describe a symmetrical object.	Demonstrate proper use of partial views in conjunction with principal views.
	x	x	x		Draw an object that can be adequately described using one view.	Discuss and describe the circumstances where one and two view drawings can be used as well as alternate positions views and removed views.

4. Classification of Surfaces and Lines	x	x	x		Indicate the ability to identify and describe accurately surface shapes by drawing the views of objects with some inclined surfaces.	Describe and discuss the similiarity of surface shapes of all view by projection.
		x	x		Analyze and draw incline and oblique surfaces.	Discuss parallelism and the relationship to adjacent views.
	x	x	x		Represent circles, holes, roundouts, fillets and cylinders.	
		x	x		Locate a point that a line intersects a plane.	Discuss the principles of determining visibility of views, lines and points on planes.
		x	x		Locate and draw a reference line to identify a reference plane for projection.	Discuss the principles of reference planes and fold lines.
B SECTIONS AND CONVENTIONS						
1. Section Views	x	x	x		Draw an object using a full section of one view.	Discuss section views, the need for them, and where they can best be used.
		x	x		Make a drawing using a half section on a symmetrically shaped object.	Discuss the principle of visualizing section views.
		x	x		Draw objects in section that use different section lining symbols.	Show different symbols for section lining. Demonstrate where section lining symbols are used and the intent they pervade.
		x	x		Draw an object using an off set cutting plane.	
		x	x		Draw an object using a broken-out or partial section.	
		x	x		Draw an object using a revolved section.	

COURSE CONTENT	SUGGESTED LEVELS I	II	III	IV	STUDENT ACTIVITIES	TEACHING ACTIVITIES
2. Conventions of Sectioning		x	x		Draw an object requiring sectioning of webs, ribs, or intermittent parts.	
			x		Draw an object having a section through where a standard part is located.	Discuss and show the conventions of drawing standard parts in section.
		x	x		Draw an object using one or more removed sections.	
			x		Draw a multi-part object assembled and in section.	
			x		Use alternate section lining for section assembly drawings.	Discuss the principles involving unnecessary hidden line details.
C. AUXILIARY VIEWS						
1. Definition of Auxiliary Views		x	x		Draw an object that uses an auxiliary view projected from a principal view.	Discuss auxuliary views, the need for them, and where and when they can best be used.
		x	x		Use reference lines to obtain dimensions and plotted curved shapes.	Demonstrate the projection and transferring of measurements in auxiliary views.

PART III - SHAPE DESCRIPTION - PICTORIAL

A. Pictorial Forms and Rendering Techniques
   1. Types or Families of Pictorials
      a. Uses of Pictorial Drawings
      b. Principles of Selecting Best Pictorial Form
      c. Principles of Centering Drawing on Sheet
      d. Requirements for Patent Drawings

   2. Pictorial Circles
      a. Kinds of Ellipses Used in Pictorial Drawings
      b. Axis Aligning of Ellipses in Pictorial Drawings

   3. Renderings
      a. Types of Rendering
      b. Continuous Tone Rendering to Various Geometric Solids
      c. Rendering Curved Surfaces on Pictorial--Holes, Fillets, Rounds, Threads and Springs
      d. Patterns for Self-adhesive Shading
      e. Airbrush Techniques

B. Axonometric Drawings
   1. Types of Axonometric Drawings
      a. Isometric
      b. Dimetric
      c. Trimetric

   2. Measuring Axonometric Drawings

   3. Non-Axonometric Lines

   4. Axonometric Circles & Curves Construction

   5. Selecting Best Axonometric Axes

   6. Standard Templates

   7. Centering Axonometric Drawings

   8. Methods of Constucting Axonometric Drawings

   9. Axonometric Thread Representation

C. Oblique Drawings
   1. Types of Obliques
      a. Advantages and Disadvantages of Oblique Drawings
      b. Principles for Positioning Oblique Drawings——

   2. Steps in Drawing Circles on Receeding Surfaces of an Oblique Drawing

D. Perspective Drawings
   1. Theory of Perspective Projection
      a. Purpose, Value and Application of Perspectives
      b. Principles for Locating Station Points and Horizon
      c. Measuring Lines and Points
      d. Steps in Locating Inclined Lines and Planes in Perspective
      e. Steps in Locating Circular Features in Perspective

PART III - SHAPE DESCRIPTION - PICTORIAL

COURSE CONTENT	SUGGESTED LEVELS I	II	III	IV	STUDENT ACTIVITIES	TEACHING ACTIVITIES
A. PICTORIAL FORMS AND RENDERING TECHNIQUES						
1. Types of Pictorials	x	x	x		Study several types of pictorial drawing. Notice the type of drawing.	Discuss the different types of pictorial drawings used in drafting.
	x	x	x			Discuss principles of selecting best pictoral forms for purpose intended.
	x	x	x		Study the principles of choosing best pictorial form to convey the intended information.	Discuss uses of pictorial drawings.
		x	x		Center a pictorial drawing in a predescribed area of a sheet.	Discuss principles of selecting best pictorial drawings on a sheet.
			x		Study several patent drawings. Notice the techniques.	Demonstrate patent drawing techniques. Discuss the patent drawing requirements.
2. Pictorial Circles		x	x		Draw elliptical circles on receeding surfaces.	Discuss the construction of ellipses used as circles in receeding surfaces of pictorial drawings.
		x	x		Establish the axis of pictorial circles for proper alignment.	Demonstrate the proper alignment of axis for circles on receeding planes.
3. Renderings			x		Study several types of rendering.	Discuss and show several types of rendering and the purpose and need for each type.
			x		Render a drawing using contrasting lines or outline rendering.	Discuss and demonstrate continuous tone rendering to various geometric solids.

COURSE CONTENT	SUGGESTED LEVELS I	II	III	IV	STUDENT ACTIVITIES	TEACHING ACTIVITIES
			x		Render a drawing using stipple rendering.	Demonstrate techniques to render curved surfaces on pictorial--holes, fillets, rounds, threads and springs.
			x		Render a drawing using self-adhesive rendering shading patterns.	Demonstrate using several patterns for self-adhesive shading.
			x		Render a drawing using airbrush shading tecniques.	Demonstrate airbrush shading techniques.
			x		Clean airbrush equipment after use.	Explain the importance of care and use of airbrush equipment.
B. AXONOMETRIC DRAWINGS						
1. Types of Axonometric Drawings	x	x	x		Draw normal surfaces in isometric projection.	Discuss the axis arrangement of isometric drawings.
	x	x	x		Draw inclined surfaces in isometic.	Demonstrate the procedure of drawing objects in isometric.
	x	x	x		Draw oblique surfaces in isometric.	
2. Standard Template		x	x		Draw circles and arcs in isometric using ellipse templates.	Show several standard templates used on axonometric drawings.

3. Measure Axonometric Drawings		x	x		Layout and draw objects in isometric form.	Discuss methods of measuring axonometric drawings
					Plot curves on axonometric planes.	Distinguish between axonometric and non-axonometric lines.
4. Non-Axonometric Lines		x	x			
5. Methods of Constructing Axonometric		x	x		Draw circles and curves on axonometric planes.	Discuss and demonstrate procedures in constructing axonometric curves and circles.
		x	x		Make an exploded axonometric drawing.	
6. Center Axonometric Drawings		x	x		Center an axonometric drawing on a sheet.	Demonstrate procedures of centering an axonometric drawing on a sheet.
		x	x		Layout and draw an object in axonometric section.	
7. Selecting Best Axonometric Axis		x	x		Draw an object using dimetric axis.	Discuss the arrangement of dimetric and trimetric axis.
8. Thread Representation		x	x		Draw thread on an axonometric representation	
C. OBLIQUE DRAWINGS						
1. Types of Obliques	x	x	x		Draw an object with the principal planes on the oblique.	Discuss the different types of obliques used to describe objects.
	x	x	x		Draw an object with angles and inclined surfaces on oblique planes.	Discuss the advantages and disadvantages of using oblique in describing an object's shape.

COURSE CONTENT	SUGGESTED LEVELS I	II	III	IV	STUDENT ACTIVITIES	TEACHING ACTIVITIES
2. Position Obliques Drawings		x	x			Discuss the principles of positioning oblique drawings.
3. Constructing Oblique Circles			x		Draw circles and arcs on oblique planes.	Demonstrate procedures of drawing circles on receeding surfaces of oblique drawings.
D. PERSPECTIVE DRAWING						
1. Theory of Perspective Projection		x	x		Draw an object using techniques of one point perspective.	Discuss and demonstrate the theory of perspective projection of drawing an object.
		x	x		Make a drawing of an object using two-point perspective.	Disucss the purpose, value, and applications of perspective procedures to represent object shape.
		x	x			Demonstrate the principles of locating station points and a horizons for perspective layout.
		x	x			Demonstrative steps in locating inclined lines and planes in perspective.
		x	x		Draw circular features of objects drawn in perspective.	Demonstrate steps in locating circular feature in prspective.
			x		Use perspective grid sheets to develop object in perspective.	Demonstrate the use of perspective grids to draw and object in perspective.

PART IV - SIZE DESCRIPTION

A. Dimensioning
   1. Importance of Exactness and Clearness of Dimensions
   2. Differences Between Size and Location Dimensions
   3. Principles of Spacing and Sequence
   4. Principles of Base Line Dimensioning
      a. Datum Line Dimension
      b. Polar Coordinates
   5. Reading Direction of Dimensions
      a. Aligned
      b. Unidirectional
   6. Tolerances
      a. Principles of Dimensional Mating Parts
      b. Expressing Tolerances
      c. Standard Fits
      d. Decimal Dimensioning
   7. Dimensioning in Limited Space
   8. Special Dimensions
      a. Reference Dimensions
      b. Superfluous Dimensions
      c. Tabular Dimensions
      d. Metric Dimensions
      e. Special Requirement for Patterns and Castings

B. Drawing Notes
   1. Location and Wording for Shop Notes
   2. Standard Abbreviations Used in Dimensioning and Notes
   3. Symbols and Scales for Degree of Finish with Finish Marks

C. Numerical Control
   1. Principles of Dimensioning for Numerically Controlled Machines
   2. True Position Dimensions
      a. Principles of True Position Dimensioning
      b. Symbols for True Position Dimensioning

D. Production Drawings

1. Types and Uses of Industrial Drawings

2. Steps in Evolution of an Idea from Design to Product Drawing

3. Elements of an Engineering Drawing Control System (Drawing Schedule)

4. Systems for Checking and Marking Drawings

5. Method's of Specifying Revisions on Drawings

PART IV - SIZE DESCRIPTION

COURSE CONTENT	SUGGESTED LEVELS I	II	III	IV	STUDENT ACTIVITIES	TEACHING ACTIVITIES
A. DIMENSIONING						
1. Exact and Clear Dimensions	x	x	x		Read a dimensioned drawing.	
	x	x	x		Learn to draw extension and dimension lines and arrowheads for size description of objects.	Discuss the importance of exactness and clearness that dimensions must have to convey the thoughts of the draftsman.
2. Size and Location Dimensions		x	x		Dimension an object with fractions and decimals.	Discuss the difference between size and location dimensions when describing the size of an object.
3. Spacing and Dimension Placement		x	x			Discuss and demonstrate the spacing of dimensions and the sequence of dimension placement.
4. Reading Direction of Dimensions		x	x		Show the difference between aligned and unidirectional placement and reading dimensions.	
5. Base Line Dimension		x	x			Discuss base line dimensions when and where to use it and its value to polor coordinates.
		x	x			Discuss the principle of dimensioning mating parts.
6. Tolerance		x	x		Dimension an object with decimals to a tolerance of .0001 of an inch.	Demonstrate the use of tolerance tables in dimensioning mating parts.

COURSE CONTENT	SUGGESTED LEVELS I	II	III	IV	STUDENT ACTIVITIES	TEACHING ACTIVITIES
		x	x			Indicate standard fits and the need for each in the engineering of assembled parts.
7. Limited Space Dimensions		x	x		Use notes to dimension special features of objects.	Discuss and demonstrate methods of dimensioning in crowded or limited space areas of a drawing.
8. Special Dimensions		x	x		Use a table to reference an object's parts.	Discuss tabular drawing, their purpose and use.
						Discuss dimensioning as to needed dimensions and superflous and reference dimensions.
			x		Make a pattern drawing for an object to be casted.	Discuss the special dimensioning problems related to foundry patterns and the resulting costings.
B. DRAWING NOTES						
1. Shop Notes		x	x		Use general notes for pattern drawings for draft or for similar directions.	Discuss how shop notes are worded and where they should be located on a drawing.
2. Standard Abbreviations		x	x		Look over the standard abbreviations used in dimensioning and notes.	Identify standard abbreviations used on machine and architectural drawings.
3. Symbols for Finish Surfaces		x	x		Use finsh marks to specify finish surfaces of objects drawn.	Discuss the symbols of the finish surface and the values the marks indicate.

C. NUMERICAL CONTROL						
1. Dimensions			x			Discuss the principles of dimensioning for numerically controlled machines.
2. True Position Dimensions			x		Read and study drawings using true position dimensioning.	Discuss the principle of true position and tolerancing and the dimensioning of drawings using these techniques.
			x			Show the symbols used in true position and tolerance dimensioning and explain how each are used.
			x			Discuss the use of polor coordinates and their use in dimensioning objects using numerical control applications.
D. PRODUCTION DRAWINGS						
1. Industrial Drawings	x	x	x			Discuss the different types and uses of industrial drawings.
2. Design of Products		x	x			Discuss the steps in the evolution of an idea for a product from design to the finished product drawing.
3. Drawing Schedule		x	x			Discuss the elements of an engineering drawing control system in the process of design, drawing and checking and marking the drawing for accuracy.

COURSE CONTENT	SUGGESTED LEVELS I	II	III	IV	STUDENT ACTIVITIES	TEACHING ACTIVITIES
			x		Use a calculator to calculate stress data for an engineering drawing.	Demonstrate use of formulas for calculating material stress limits.
4. Marking and Checking Drawings		x	x		Study the checking routine used by some industries.	Demonstrate the checking routine and procedure of industrial drafting rooms.
5. Revision Specifications			x		Revise a drawing and record the revision.	Discuss revision procedures of industrial drafting rooms and explain the methods of recording revisions.
			x		Zone a large assembly drawing.	

PART V - QUANTITY AND LOCATION DESCRIPTION

A. Maps
   1. Types and Uses of Maps

   2. Symbols Used on Maps

B. Charts and Graphs
   1. Types and Uses of Charts

   2. Content Features of Charts

   3. Selecting Proper Use.

PART V - QUANTITY AND LOCATION DESCRIPTION

COURSE CONTENT	SUGGESTED LEVELS I	II	III	IV	STUDENT ACTIVITIES	TEACHING ACTIVITIES
A. MAPS						
1. Types of Maps	x	x	x		Study several types of maps to see the need and use of each.	Discuss the types and the uses of different maps used by several areas of industry and the government.
2. Map Symbols		x	x		Learn the general map symbols for description clarity.	Show the commonly used symbols found on different types of maps.
		x	x		Use several types of self adhesive topographic symbols.	
		x	x		Draw a topographic map of assigned area with appropriate contour lines.	
B. CHARTS AND GRAPHS						
1. Types		x	x		Select a chart or graph to convey facts or data.	Describe and discuss several types of charts and show how they are used in industry, business and government.
			x		Draw a flow chart.	Describe flow processes of production.
2. Chart Features and Selection		x	x		Draw a bar, line, circle and/or pictograph to convey facts or data.	Indicate the special features of charts and graphs and how to select each for best use.

PART VI - GRAPHIC GEOMETRY

A. Geometric Construction
   1. Enlarging or Reducing a Design
      a. Grid Square Method
      b. Diagonal Method
      c. Proportional Dividers
      d. Pantograph

   2. Purpose and Use of Studying Geometrical Construction

   3. Relationship of Geometry of Drawing and Mathematics

   4. Geometric Construction Used in Numerical Control

   5. Kinds of Geometric Shapes

   6. Tangents

   7. Direction of Lines by Azimuth and Magnetic Bearing

B. Descriptive Geometry--Points & Lines
   1. Applications of Descriptive Geometry

   2. Principles of the Cartesian Coordinate System (Space Directions)

   3. Importance of Labeling Points of Lines

   4. Geometry of Lines
      a. Intersecting and Non-Intersecting Lines
      b. Principles for Idenfifying Perpendicular
      b. Principles for Identifying Perpendicular Lines
      c. Definitions and Uses of Bearing and Scope of Lines

C. Descriptive Geometry--Planes
   1. Methods of Representing a Plane
   2. Types or Names of Planes
   3. Uses of True Shape Views of Planes

4. Geometry of Planes
   a. Types of True Length Lines on a Plane
   b. Methods of Indicating Slope of a Plane

D. Descriptive Geometry--Revolution

1. Principles of Revolution
   a. Purpose of Revolution Method
   b. Elements of Revolution
   c. Axis of Revolution
   d. Extreme Positions on Path of Revolution
   e. Surfaces Generated by a Line Revolved About Another Line

2. Dihedral Angles.

PART VI - GRAPHIC GEOMETRY

COURSE CONTENT	SUGGESTED LEVELS I	II	III	IV	STUDENT ACTIVITIES	TEACHING ACTIVITIES
A. GEOMETRY CONSTRUCTION						
1. Manipulate Design Size	x	x	x		Reduce or enlarge a design by the grid method.	Demonstrate [illegible]n enlargement and reduction by s[illegible]ethods and tools.
		x	x		Use diagonals to reduce a design.	
		x	x		Use proportional dividers to change the scale of a drawing.	
			x		Reproduce a design with a pentograph to a different scale.	
2. Purpose of Geometric Construction	x	x	x		Draw parallel and perpendicular lines with T-Square and triangles.	Discuss the purpose and use of geometric construction in the development of geometric figure.
		x	x		Learn to biscect arcs, angles and lines with a scale, triangle and dividers.	Carefully explain the relationship of geometry of drawing and geometry of mathematics.
3. Geometry		x	x		Draw regular polygons with triangles and/or a compass and dividers.	
4. N/C Geometry			x			Discuss the value and application of geometric construction to numerical control practices.
		x	x		Divide a line into any number of equal parts with a scale.	

COURSE CONTENT	SUGGESTED LEVELS I	II	III	IV	STUDENT ACTIVITIES	TEACHING ACTIVITIES
5. Geometric Shapes		x	x			Review the basic geometric shapes from which all objects are constructed.
6. Tangents		x	x		Draw tangents of circle to line and circle to circle.	Discuss the basic concept of tangents.
		x	x		Learn to draw an ellipse by the approximate method.	
7. Describe Direction of Lines			x		Layout azimuth bearings of a line.	Discuss navigational application relating to maps.
				x	Layout magnet bearing of a line.	Discuss the magnetic variations of the earth and the affect on magnetic bearings.
B. POINTS AND LINES						
1. Applications of Descriptive Geometry			x	x	Solve and draw the true length of lines and shape of planes of inclined surfaces.	Discuss the applications of descriptive geometry to identify true length and shapes of lines and planes.
			x	x	Locate a point on a given line or plane.	
2. Cartesian Coordinate System			x	x	Locate points and lines by XYZ coordinates.	Discuss and show the principles the cartesian coordinate system on perpendicular axis.
			x	x	Draw intersecting line from any angle.	

3. Labeling Points of Lines		x	x			Dicuss the importance of labeling points of lines for reference.
		x	x		Obtain the true length of a straight line from points given on two lines.	
4. Geometry of Lines			x		Draw a perpendicular line from a point on a plane.	Discuss the types of lines, principles of identifying perpendicular lines and uses of bearings and slope lines.
			x		Draw a perpendicular line from a point on a given line.	
C. PLANES						
1. Methods of Representing a Plane			x		Prove the existence of a plane by showing it in its true shape.	Discuss and show how planes are represented and identified.
2. Types of Planes			x		Add a horizontal, frontal or profile line to a given plane.	Describe the types and/or names of different planes.
			x		Determine visibility of lines and planes.	
3. Use of True Planes		x	x		Draw a plane parallel to a line and a line parallel to a plane.	Discuss the uses of true shape views of planes.
4. Geometry of Planes			x		Find the true angle a line makes with a plane.	Describe types of true length lines on a plane.
			x		Find the true angle between two given planes.	Describe methods of indicating slope of a plane.

COURSE CONTENT	SUGGESTED LEVELS I	II	III	IV	STUDENT ACTIVITIES	TEACHING ACTIVITIES
D. REVOLUTION						
1. Principles of Revolution		x	x		Find the true length of a line by revolution.	Describe the principles of revolution, the purpose of the method, its elements and axis.
			x		Find the true size of a plane by revolution.	
			x			Identify extreme positions on path of revolution.
			x		Find the angle between planes by revolution.	
2. Dihedral Angles			x			Discuss the procedure for identifying dihedral angles of intersecting planes.

PART VII - MACHINE DESIGN

A. Production Processes and Materials

1. Principles of Designing for Shop Processes
   a. Pattern Shop and Drafting Procedures
   b. Shearing and Forming Process and Drafting Procedures
   c. Shaping Processes and Drafting Procedures
   d. Fabrication Processes and Drafting Procedures
   e. Finish Processes and Drafting Procedures

2. Materials
   a. Shapes and Forms of Common Stock
   b. Ferrous and Non-Ferrous metals

3. Tools
   a. Names and Uses of Precision Measuring Equipment
   b. Types of Fits
   c. Machine Tool Processes
   d. Purposes of Jigs and Fixtures

B. Fasteners and Fabrications

1. Types of Threaded fasteners

2. Terminology of Fasteners

3. Types of Non-Threaded Fasteners

4. Types of Joints and Welds Used in Fastening

C. Machine Elements--Cams, Gears, Springs

1. Cams
   a. Cam Terminology
   b. Types and Uses of Cams
   c. Cam Shapes and Displacement Diagrams
   d. Factors Governing Cam Sizes

2. Gears
   a. Gear Terminology
   b. Types of Gears
   c. Characteristics and Uses of Gears
   d. Materials Used to Manufacture Gears
   e. Principles of Gear Design
   f. Method of Specifying Gear Data
   g. Formula for Figuring Gear Ratios

3. Springs
   a. Types of Springs
   b. Application of Springs
   c. Size and Specification of Springs

PART VII - MACHINE DESIGN

COURSE CONTENT	SUGGESTED LEVELS I	II	III	IV	STUDENT ACTIVITIES	TEACHING ACTIVITIES
A. PRODUCTION PROCESSES AND MATERIALS						
1. Design for Shop Processes		x	x			Discuss the principles of designing for shop processes.
		x	x			Show the relationship between the pattern shop, shearing and forming procedures, shaping processes, fabrication processes, and finishing processes with the drafting procedures.
2. Materials		x	x			Show the common shapes of stock of materials used in machine design.
		x	x			Discuss the use of ferrous and non-ferrous metals in machine design.
B. FASTENERS AND FABRICATIONS						
1. Threaded Fasteners		x	x		Draw standard symbols of threaded fasteners.	Discuss the specifications of threaded fasteners used in the fabrication of machines.
2. Thread Terminology		x	x		Designate specific fasteners using notes.	Describe thread fastener terminology and the order of specifying fasteners.
	x	x	x		Identify standard types and sizes of fasteners from tables and handbooks.	
3. Non-Thread Fasteners			x			Discuss the specifications of non-threaded fasteners used in the fabrication of machines.

4. Joints and Welds			x		Apply welding symbols to drawings to identify methods of joining machine parts.	Show and describe the several joints and welds used to fasten part of machines.
			x		Use rivets and retaining rings as fasteners of machine parts on machine drawings.	
C. CAMS, GEARS, SPRINGS						
1. Cams			x		Draw a radial cam with its follower from a displacement diagram.	Discuss function and types of cams used in industry on machines.
			x			Describe cam terminology.
			x		Develop a face cam from a displacement diagram.	Explain the function of the displacement diagram and how it can determine the shape of the cam thus the action.
			x		Draw a cylindrical end cam from a displacement diagram.	
			x			Discuss the relative factors governing cam sizes.
			x		Show both motion of cam and shape of cam.	Describe how the type of follower can affect the shape of the cam.
			x			Discuss the data needed on a cam drawing for its construction.

COURSE CONTENT	SUGGESTED LEVELS I	II	III	IV	STUDENT ACTIVITIES	TEACHING ACTIVITIES
2. Gears			x			Describe the nominclature of gears.
			x			Discuss the kinds and uses of different types of gears.
			x		Make a table giving data necessary for machining gear teeth.	Discuss the data needed on a gear drawing for gear construction in a tooth data table.
			x		Demonstrate the ability to draw a spur gear, bevel gear, rack and pinion gear and a worm gear and worm.	Discuss the principles of gear design and the materials suited for particular problems.
			x		Calculate gear data to provide size and strength required for a particular problem.	Describe the calculations necessary to determine ratio, gear size, gear width and shaft size to provide for a speed and power for a given problem.
3. Springs			x		Specify a particular spring for a machine design being planed.	Discuss the types, the application and sizes of standard springs needed for machine design.
			x		Draw a spring in an assembly section of orthographical projection.	
			x		Draw a spring in an assembly section of an axonometric drawing.	

PART VIII - ARCHITECTURAL

A. Home Planning

1. Content of Typical Set of Plans
   a. Nominclature of Plans
   b. Types of Details
   c. Symbols for Plans
   d. Specifications

2. House Design
   a. Zoning
   b. Traffic Circulation
   c. Storage Requirements
   d. Sources of Information for Standards of Sizes
   e. Room Layout--Kitchens, Bathrooms, Laundry Rooms

3. Building Orientation
   a. Site Selection and Location
   b. Sun and Wind Orientation
   c. Placement of Windows and Doors

4. Characteristics of Architectural Styles
   a. Roof, Windows
   b. Structural Materials

5. Cost Estimating of Structures

B. Presentation

1. Presentation Drawings

2. Dimensioning Architecture Drawings

3. Scale Used in Architecture Drawings

C. Models

1. Types and Uses of Models, Mockups, and Phototypes

2. Materials of Model Making

PART VIII - ARCHITECTURAL

COURSE CONTENT	SUGGESTED LEVELS I	II	III	IV	STUDENT ACTIVITIES	TEACHING ACTIVITIES
A. HOME PLANNING						
1. Typical Set of House Plans	x	x	x		Learn to read a set of typical house plans.	Discuss the contents of a typical set of house plans.
		x	x			Describe the nominclature of architecture drawings.
		x	x		Make detail drawings that supplement a set of house plans.	Discuss method and contents of types of details used in architectural drawings.
		x	x		Use symbols on drawing that will help to describe intention of draftsman and/or architect.	Show the different symbols used on house plans and show how each is used.
		x	x		Write complete specifications for a one-family residence to supplement a set of house plans.	Discuss the purpose and centent of building specifications.
2. House Design			x		Plan a house for a specific family with a specific income.	Discuss the factors of zoning and traffic circulation in the layout of rooms for a house.
			x		Plan storage facilities for a specific family.	Discuss storage requirements for a home.
			x			Display sources of information for building standards and sizes.
			x		Plan kitchen, bathroom and laundry and utility room facilities for the house being planned.	Discuss the special planning problems of kitchens, bathrooms, and utility and laundry rooms.

3. Building Orientation			x			Discuss the elements of orientation of the building on the site to sun, wind and view.
4. Characteristics of Architecture Styles			x		List the major architectural styles of the world.	Discuss the distinguishing features and characteristics of architectural styles including windows, doors, roof types (pitch and texture) and exterior wall cover.
			x			Discuss how the availability of material and social mores and customs affect architectural style of houses.
5. Cost Estimating			x			Discuss the process of calculating material amounts and quantities for construction cost estimates.
			x			Discuss the problems and practice of buying materials for building construction.
			x		Estimate the cost of a one-family house using learned procedures and references.	Acquaint students with reference materials to calculate the cost of a house.
B. PRESENTATIONS						
1. Presentations Drawings			x		Make set of drawings for a one-family dwelling. Include the plot and floor plans, elevations, details and window and door schedules.	Discuss which plans the presentation drawings should include.
2. Architectural Scales, Notes and Symbols			x			Describe how the drawings are scaled and symbols and notes are used.

COURSE CONTENT	SUGGESTED LEVELS I	II	III	IV	STUDENT ACTIVITIES	TEACHING ACTIVITIES
3. Architectural Drawing Dimensions			x		Dimension floor plans and architectural details.	Show how architectural drawings and details are dimensioned.
C. MODELS						
1. Types of Models, Mock-ups & Phototypes			x			Discuss the types of models, mock-ups, and phototypes to display and present architectural designs.
2. Material for Models			x		Construct a model for structural presentation.	Display materials, sources, and techniques for modelmaking.

PART IX - SPECIALITY CATEGORIES

A. Electrical and Electronics Drawings

1. Electronic Symbols Used on Schematics
2. Electrical Symbols Used in Architectural Plans
3. Principles of Laying Out a Printed Circuit

B. Intersections and Developments

1. Geometric Solids, Plane Figures and Surfaces
2. Finding True Lengths of Lines
3. Methods of Developing Surfaces
4. Transition Pieces
5. Air Duct Layout

C. Pipe Layouts

1. Pipe Drawing
   a. Single and Double Line Layout
   b. Dimensioning Standards
   c. Factors in Arranging and Spacing Pipe
2. Pipe Features
   a. Types of Pipe Fittings
   b. Types and Functions of Valves
   c. Materials of Pipes, Fittings and Valves
   d. Sizes of Pipes, Fittings and Valves
   e. Principles of Selecting Valves, Fittings and Pipes
3. Joining Pipes and Fittings
   a. Standard Abbreviations for Threads
   b. Uses of Straight and Tapered Pipe Threads
   c. Types of Flanges and Flange Facings
   d. Standard Pipe Detail Welding Symbols
4. Plumbing Layout

D. Structural Drawing

1. Characteristics of Structural Drawings
   a. Structural Steel Shapes
   b. Structural Steel Terminology
   c. Conventional Symbols
   d. Dimensioning Principles

2. Procedure for Computing Loads and Stress Analysis

PART IX - SPECIALITY CATEGORIES

COURSE CONTENT	SUGGESTED LEVELS I	II	III	IV	STUDENT ACTIVITIES	TEACHING ACTIVITIES
A. ELECTRICAL and ELECTRONIC DRAWINGS						
1. Electronic Symbols	x	x	x		Read schematic diagrams of electronic devices.	Discuss the procedures and symbols used in the layout of electronic schematics.
			x		Draw block diagrams of electronic devices.	
2. Electrical Diagram Symbols		x	x		Read wiring diagrams of electrical circuits.	Discuss the symbols and layout of wiring diagrams for architectural plans.
			x		Draw a wiring diagram for a house.	
3. Printed Circuits			x		Draw a layout for a printed circuit.	Discuss the procedures of drawing printed circuit layouts.
			x		Enlarge a printed circuit layout.	Describe the process of enlargements of printed circuit layouts.
B. INERSECTIONS and DEVELOPMENTS						
1. Geometric Solids, Plane Figures and Surfaces		x	x		Identify several regular geometric solids, plane figures and surfaces.	Discuss the names, shapes, and characteristics of common geometric solids, plane figures and surfaces.
		x	x		Layout the development of geometric solids (prisms, pyramids and cylinders).	Demonstrate methods of finding true lengths of lines.

COURSE CONTENT	SUGGESTED LEVELS I	II	III	IV	STUDENT ACTIVITIES	TEACHING ACTIVITIES
2. Finding True Length Lines		x	x		Find the true length of lines on surfaces.	Describe methods of finding true lengths of lines.
		x	x		Find the intersection of a line and a surface.	Describe the procedures of solving problems of lines and surface intersecting.
			x		Find the intersection of a plane and a cylinder.	
3. Surface Developments		x	x			Describe methods of developing surfaces that make the sides of geometric solids.
			x		Find the intersection of a prism and a cylinder.	
		x	x			Discuss the types of surfaces that can be develop and why some cannot be developed.
		x	x			Discuss and describe the allowances used in developing lateral surfaces.
4. Transition Pieces			x		Layout the development of a transition piece connecting two cylindrical pipes.	Describe the procedure of triangulation and the development of transitional pieces.
5. Air Duct Layout			x		Make an air duct layout from a furnace and an air conditioner to room disfusers.	Discuss the layout and calculations of a system to carry forced air from a furnace or an air conditioner to room disfusers.

			x		Calculate the size in square area and length of air carrying ducts.	Demonstrate methods and reference charts to calculate air duct sizes to carry air quantities.
C. PIPE LAYOUTS						
1. Pipe Drawings			x		Make a single and double line layout for a pipe system to carry fluids.	Discuss the procedures and factors to consider in the arrangement and spacing pipes in fluid carrying system.
			x		Draw orthographic views of a piping system.	
			x		Draw a flow diagram of a pipe system.	Describe dimensioning standards used in pipe system drawings.
			x		Draw bends and fabrication details of a pipe system.	
2. Pipe Features			x			Discuss and describe types, sizes, and materials of different pipe fittings used in pipe layouts.
			x			Discuss the different types of pipe valves and each one's particular function.

COURSE CONTENT	SUGGESTED LEVELS I	II	III	IV	STUDENT ACTIVITIES	TEACHING ACTIVITIES
3. Joining Pipes and Fittings			x		Select appropriate valves, fittings and flanges from handbooks for a planned pipe system.	Discuss the principles of selecting sizes of pipe, kinds of valves and fittings used to develop the layout of a pipe system.
			x		Compute a bill of material for a planned pipe system.	Demonstrate procedures to compute bills of material for a pipe system.
			x			Describe standard abbreviations for threads of pipes and fittings.
			x			Show methods of specifying threads and thread standards.
			x			Discuss the uses of straight and tapered pipe threads for most fittings.
			x			Describe types of flanges and flange facings used on types of valves and pipe fittings.
			x		Draw pipe diagrams using welding symbols to indicate joining methods of fittings and pipes.	Discuss and show standard pipe detail welding symbols used in pipe diagram drawings.
4. Plumbing Layout			x		Make a pictorial pipe layout for the plumbing of a one-family residence.	Discuss and show regular pipe layout for residential plumbing (both orthographical and pictorial).

D. STRUCTURAL DRAWING						
1. Characteristics			x	x	Draw a structural steel drawing using single line diagram techniques.	Describe structural steel shapes available for structural erection.
			x	x		Discuss and show structural steel diagram terminology used on drawings.
			x	x	Draw beam and column details on structural drawings.	
			x	x		Show use and place of standard structural steel symbols.
			x	x	Complete structural diagram by adding necessary dimensioning.	Show principles used to determine the dimensioning structural steel drawing.
2. Computing Load and Stress Analysis			x	x	Compute the safe load structural member can safely carry in a given structure.	Discuss and show procedures to calculate load carried by structure members.
			x	x		Discuss practices of computing stress analysis on structural members.

APPENDICES

Appendix A--Bibliography

Appendix B--Publishers Address List

Appendix C--Films

Appendix D--Film Sources

Appendix E--Occupational Information

Appendix F--Suggested Drafting Equipment

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(Taken from *Books for Occupational Education Programs*, R.R. Bowker Co., 1180 Avenue of the Americas, New York, N.Y. 10036.

APPENDIX B

PUBLISHERS ADDRESS LIST

Abelard-Schuman, Ltd., 6 West 57th Street, New York, New York 10019

Aero Publishers, 329 Aviation Road, Fallbrook, California

Aldine Publishing Co, 320 West Adams Street, Chicago, Illinois 60606

American Heritage Publishing Co., 551 5th Avenue, New York, New York 10017

American Technical Society, 848 East 58th Street, Chicago, Illinois 60637

Appleton Century (Div. of Meredith Press), 250 Park Avenue, New York, New York 10017

Arco Publishing Co., Inc., 219 Park Avenue, South New York, New York 10003

Charles A. Bennett Co., Inc., 809 Detweiler Drive, Peoria, Illinois 61614

Bentley, Robert, Inc., 872 Masachusetts Avenue, Cambridge, Mass. 02139

Bobbs-Merrill Co., Inc., (Div. of Howard W. Sams & Co., Inc.), 4300 West 62nd Street, Indianapolis, Indiana 46206

Bruce Publishing Co., 400 North Broadway, Milwaukee, Wisconsin 53201

Chilton Book Company, 401 Walnut Street, Philadelphia, Penn. 19106

Coward-McCann, Inc., 200 Madison Avenue, New York, New York 10016

Crowell, Collier Educational Corp. (Div. of Crowell, Collier and Macmillan, Inc.), 866 Third Avenue, New York, New York 10022

Crown Publishers, Inc., 419 Park Avenue, South New York, New York 10016

Deluis, Kasing and Co., Siekerwall 21, Bielfeld, Germany

Dial Press, 750 Third Avenue, New York, New York 10017

Dodd, Mead and Co., 79 Madison Ave., New York, New York 10016

Doubleday and Co., Inc., 277 Park Avenue, New York, New York 10017.

R.C. Dresser, Boston, Massachusetts 02101

Duell, Sloan and Pearce, 250 Park Avenue, New York, New York 10017

Faber and Faber, 24 Russell Square, London, England WCI

Funk and Wagnalls Co., (Div. of Readers Digest Books), 380 Madison Avenue, New York, New York 10017

Goodheart, 18250 Harwood Avenue, Homewood, Illinios 60430

Grossman Publishers, Inc., 125A East 19th Street, New York, New York 10003

Paul Hamlyn, 583 Fulham Road, London, England SW6

Hanover House, Garden City, New York 11530

Harcourt, Brace and World, Inc., 757 3rd Avenue, New York, New York 10017

Harper and Row Publishers, 49 East 33rd Street, New York, New York 10016

Hayden Book Company, (J.F.Rider Division) 116 West 14th Street, New York, New York 10011

Iliffee NTP Inc., 300 East 42nd Street, New York, New York 10017

Industrial Relations Counselors, 1270 Avenue of the Americas, New York, N.Y. 10020

Iowa State University Press, Press Building, Ames, Iowa 50010

Lippincott, J.B. Co., East Washington Square, Philadelphia, Penn. 13673

Little, Brown and Co., 34 Beacon Street, Boston, Mass. 02154

Maclaren and sons, 268 Argyle Street, Glasgow, C2, Scotland

Macmillan Company (Div. of Crowell, Collier, and Macmillan) 866 3rd Avenue, New York, New York 10022

Meredith Press, 250 Park Ave., New York, New York 10017

Julian Messner, Inc., 1 West 39th Street, New York, N.Y. 10018

McKnight and McKnight Publishing Co., 29 East 10th St., N.Y., N.Y. 10003

McNally and Laftin, Publishers, 114 East De La Guerra St., Box 1316, Santa Barbara, California 93102

John Murray, Ltd., 50 Albmarle Street, London, England W1

New Horizons Publishers (Div. of Fuller & Dees Marketing Group), 154 East Erie Street, Chicago, Ill. 60611

Oceana Publications, Inc., 40 Cedar Street, Dobbs Ferry, New York 10522

Oxford Book Company, 71 5th Ave., New York 10003

Pergamon Press, Inc., 122 East 55th St., New York, New York 10022

Printing Industries of America, 20 Chevy Chase Circle, N.W. Washington, D.C. 20015

Putnam's G.P Sons, 200 Madison Ave., New York, New York 10016

Reinhold Publishing Corp., 430 Park Ave., N.Y., N.Y. 10022

Richards Rosen Press, Inc., 29 East 21st Street, New York, New York 10011

Ronald Press Co., 79 Madison Ave., N.Y., N.Y. 10016

St. Martins Press, Inc., 175 5th Ave., New York, N.Y. 10010

Sampson Law, Marston (Distributed by Ginn & Co.), Boston, Mass. 02101

Howard W. Sams & Co., Inc., 4300 West 62nd Street, Indianapolis, Ind. 46206

Scholastic Book Services, Scholastic Magazines, 50 West 44th St., N.Y., N.Y. 10036

Scribner's Charles Sons, 597 Fifth Avenue, N.Y., N.Y. 10017

Sterling Publishing Co., Inc., 419 Park Ave., South N.Y., N.Y. 10016

Superior Publishing Co., 708 6th Ave., North, Box 1710, Seattle, Wash. 98111

Technical Publications, Inc., 934 Wyandotte St., Kansas City, Minn. 64105

Times-Life Books (Div. of Time, Inc.), Time & Life Bldg., N.Y., N.Y. 10020

Van Nostrand, D. Co., Princeton New Jersey 80540

Walck, Henry Z., Inc. 19 Union Square, West, N.Y., N.Y. 10003

Ziff-Davis, 595 Broadway, New York, New York 10021

American Technical Society, 848 EAst 58th St., Chicago, Ill. 60637

Atlas Press Co., 1822 North Pitcher St., Kalamazoo, Mich. 49007

W.A. Benjamin, Inc., 2465 Broadway, New York 25, N.Y

Cincinnati Milling Machine Company, Cincinnati, Ohio

Delmar Publishers, Inc., Mountain View Ave., Albany, N.Y. 12205

John L. Lincoln Arc Welding Foundation, Cleveland, Ohio

Technical Education Division, McGraw-Hill Book Co., 330 W. 42nd St., N.Y., N.Y. 10036

North American Publishing Co., 134 No., 13th St., Philadelphia, Penn.

South Bend Lathe Works, South Bend, Indiana

The Steck Co., Box #2028, Austin, Texas 78765

John Wiley & Sons, Inc., 605 Third Ave., N.Y., N.Y. 10016

and others

FILMS

INRODUCTION TO DRAFTING

Drawing For Beginners, Elementary, Junior High, or High School
Institutional Dinema, 10 minutes

INTRODUCTION TO MECHANICAL DRAWING

TOOLS

"Instruments and Materials," 18 minutes, silent
Illinois Institute of Technology
3300 Federal Street
Chicago, Illinois

"Drawing Instruments," silent, Gramercy
Gramercy Guild Group, Inc.
116 Broad Street
New York 4, New York

LETTERING

"Capital Letters," 20 minutes, sound, movie
Purdue Research Foundation
Lafayette, Indiana

"Technical Lettering Filmstrips"
Jam Handy Organization
2900 East Grand Boulevard
Detroit 11, Michigan

GEOMETRICS

"Applied Geometry," 16 minutes, silent
Purdue Research Foundation
Lafayette, Indiana

"Geometric Construction, Parts 1 and 2," Filmstrips
Jam Handy Organization
2900 East Grand Boulevard
Detroit 11, Michigan

LINES

"Line," 1 reel, sound
Photo and Sound Company
116 Natoma Street
San Francisco 5, California

MULTIVIEW

"Orthographic Projection," 18 minutes, sound
Brigham Young University Audio-Visual
Library
Provo, Utah

"Shape Description," Part I, 15 minutes, sound--Part II, 10 minutes, sound
McGraw-Hill Book Company
330 West 42nd Street
New York 36, New York

DIMENSIONING

"Drawing an Anchor Plate," filmstrips
Jam Handy Organization
2900 East Grand Boulevard
Detroit 11, Michigan

"Selection of Dimensions," 18 minutes, sound

"Principles of Dimensions, Reference Surface and Tolerances," 12 minutes, sound
United World Films, Inc.
1445 Park Avenue
New York 29, New York

AUXILIARY

"Auxiliary Views," single auxiliary, sound, double auxiliary, sound
Brigham Young University Audio-Visual Library
Povo, Utah

"Auxilary Views," Parts 1 and 2, 10 minutes, sound
McGraw-Hill Book Company
330 West 42nd Street
New York 36, New York

SECTIONS

"Sections and Conventions," 15 minutes, sound
Brigham Young University Audio-Visual Library
Provo, Utah

"Sections," 10 minutes, sound
McGraw-Hill Book Company
330 West 42nd Street
New York 36, New York

PICTORIALS

"Pictorial Sketching," 11 minutes, sound
McGraw-Hill Book Company
330 West 42nd Street
New York 36, New York

"Perspective Drawing," 8 minutes, sound
University of California
Education Films Department
University Extensions
Los Angeles 24, California

SHEET METAL

"Simple Developments," 11 minutes, sound
McGraw-Hill Book Company
330 West 42nd Street
New York 36, New York

"Oblique Cones and Transition Development," 11 minutes, sound
McGraw-Hill Book Company
330 West 42nd Street
New York 36, New York

SKETCHING

"Pictorial Sketching," 11 minutes, sound
McGraw-Hill Book Company
330 West 42nd Street
New York 36, New York

THREADS AND FASTENERS

"Cutting Threads with Taps and Dies," 20 minutes, sound
Bell and Howell Company
7100 McCormick Avenue
Chicago, Illinois

PRODUCTION PROCESSES

"Shop Procedures," 17 minutes, sound
McGraw-Hill Book Company
330 West 42nd Street
New York 36, New York

ARCHITECTURAL

"Home Place," 30 minutes, sound
U.S. Department of Agriculture
Washington 25, D.C.

"Modern Architecture," 9 minutes, sound
News Magazine of the Screen
33 West 60th Street
New York 23, New York

"Modern Kitchen, Ideas and More Room at Home," sound
American Plywood Association
Tacoma 2, Washington

"Problems of Housing," 10 minutes
Brigham Young University Audio-Visual Library
provo, Utah

ELECTRICITY-ELECTRONICS

"Learning About Electrical Current," 1 reel, sound
American Museum of Natural History Film Library
Central Park West 79th Street
New York 24, New York

"Basic Elecricity," 19 minutes, sound
United World Films, Inc.
1445 Park Avenue
New York 29, New York

WELDING

"Design for Arc Welded Structures," 15 minutes, sound
Stected Motion Pictures
799 Stevenson Street
San Francisco 3, California

CAMS AND GEARS

"Cutting Teeth on a Worm Gear," 17 minutes, sound
United World Films, Inc.
1445 Park Avenue
New York 29, New York

ILLUSTRATION

"Broad Stroke Drawing," 19 minutes, sound
Ideal Pictures Corporation
28 East Eighth Street
Chicago 5, Illinois

ELECTRICAL CODE

"Visual Sciences, Radio and Electronics Symbols," 40 minutes
Box 599 DM Suffern
New York, New York

"Elements of Electrical Circuits," 11 minutes, sound
Brigham Young University Audio-Visual Library
Provo, Utah

"Correlated Text-Film Filmstrip Series"
"Mechanical Drawing Series, Set 3"
"Mechanical Drawing Series, Set 4"
McGraw-Hill Book Company
330 West 42nd Street
New York 36, New York

TRANSPARENCY

Technical Graphics AR and E Educator Approved
Diazo Transparency Master Units--$76

Architectural Drawing Transparencies
McGraw-Hill Correlated Audio Visual Aids--$36

Mechanical Drawing Series Transparency
McGraw-Hill Correlated Audio Visual

APPENDIX D

INSTRUCTIONAL AIDS

FILM SOURCES

Army (U.S. Army -- Obtainable
from Castle Films, Inc.)
Castle Films
30 Rockefeller Plaza
New York 20, New York

Cocking, Floyd W.,
4757 Constance Drive
San Diego, Calfifornia

Educators Progress Service
Randolph, Wisconsin

Fi Pr-Film Production Company
3650 North Freemont Avenue
Minneapolis, Minnesota

Gisholt Machine Company
1245 East Washington Avenue
Madison 3, Wisconsin

Ideal Pictures Corporation
28 East 8th Street
Chicago 5, Illinois

Sterling Movies, Inc.
100 W. Monroe Street
Chicago 3, Illinois

N.Y.U.-- New York Univ. Film Library
26 Washington Square
New York City 3, New York

Frederick Post Company
2635 N. Hamilton Avenue
Chicago, Illinois

Bell and Howell Company
7100 McCormick Avenue
Chicago, Illinois

Chicago Board of Education
228 No. Lasalle Street
Chicago, Illinois

Jam Handy Organization
2900 East Grand Blvd.
Detroit 11, Michigan

McGraw-Hill Book Company
330 West 42nd Street
New York 36, New York

Massachusetts Institutes of Technology
Division of Visual Education
Cambridge, Massachusetts

Purdue Research Foundation
Lafayette, Indiana

Pennsylvania State College
Film Library
State College, Pennsylvania

United World Films, Inc.
1445 Park Avenue
New York 29, New York

University of California
Education Films Department
University Extensions
Los Angeles 24, California

SELECTED SOURCES FOR OCCUPATIONAL INFORMATION*

The agencies and associations listed will provide, upon request, information about occupations and professions specificially related to their fields.

INDUSTRY, AGENCIES AND ASSOCIATIONS

AEROSPACE

Aircraft Industries Association, 15th and H Sts., N.W., Washington, D.C. 20001.
American Institute of Aeronautics and astronautics, Inc., 1290 Avenue of the Americas, New York, N.Y. 10019.
Institute of the Aeronautical Sciences, Two E. 64th St., New York, N.Y 10021.
National Aerospace Education Council, Suite 616, Shoreham Bldg., 806 15th St., N.W., Washington, D.C. 20005.
Public Relations, Air Transport Association of America, 1000 Connecticut Ave., N.W., Washington, D.C. 20036.

AUTOMOTIVE

Allis-Chalmers Manufacturing Co., Public Relations Division, P.O. Box 512, Milwaukee, Wis. 53201.
American Institute of Mining, Metallurgical and Petroleum Engineers, 345 E. 47th St., New York, N.Y. 10017.
American Petroleum Institute, 1625 K St., N.W., Washington, D.C. 20006.
American Trucking Association, 1616 P St., N.W., Washington, D.C. 20036.
Arabian-American Oil Co., 505 Park Ave., New York, N.Y. 10022.
Association of American Railroads, Transportation Bldg., Washington, D.C. 20006.
Automobile Manufacturers Association, 320 New Center Bldg., Detroit, Mich. 48202.
General Motors, Education Department, Mound Road and 13 Mile, Detroit, Mich. 48202.
Shell Oil Co., 50 W. 50th St., New York, N.Y. 10020.
Standard Oil Co. of New Jersey, 30 Rockefeller Plaza, New York, N.Y. 10020.

DRAFTING

American Advertising Federation, Bureau of Education and Research, 655 Madison Ave., New York, N.Y. 10021.
American Congress on Surveying and Mapping, Woodward Bldg, Washington, D.C. 20005.
American Institute of Architects,, 1735 New York Ave., N.W., Washington, D.C. 20006.
American Institute of Industrial Engineers, 345 E. 47th St., New York, N.Y. 10017.

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*Guidance in Industrial Arts Education for the 70's, American Council of Industrial Arts Supervisors, American Industrial Arts Association

American Society for Oceanographers, 906 C and I Bldg., Houston, Texas 77002.
American Society of Civil Enginners, 345 E. 47th St., New York, N.Y. 10017.
American Society of Landscape Architects, Inc., 2000 K St., N.W., Washington, D.C. 20006.
American Society of Photogrametry, 105 N. Virginia Ave., Falls Church, Va. 22044.
Cartoonists Society, 247 W. 43rd St., New York, N.Y. 10036.
Engineers Council for Professional Development, 345 E. 47th St., New York, N.Y. 10017.
Industrial Designers Society of America, 60 W. 55th St., New York, N.Y. 10019.
National Oceanographic Association, 1900 L St., N.W., Washington, D.C. 20036.
National Society of Interior Designers, Inc., Suite 700, 157 W. 57th St., New York, N.Y. 10019.

ELECTRICAL/ELECTRONICS

American Institute of Electrical Engineers, 345 E. 47th St., New York, N.Y. 10017.
American Registry of Radiological Technologists, 2600 Wayzata Bend, Minneapolis, Minn. 55405.
American Women in Radio and Television, Inc., 75 E. 55th St., New York, N.Y. 10022.
Institute of Radio Engineers, One E. 79th St., New York, N.Y. 10021.
International Brotherhood of Electrical Workers, 1200 15th St., N.W., Washington, D.C. 20005.
National Association of Radio and Television Broadcasters, 1771 N. St., N.W., Washington, D.C. 20036.
National Electrical Contractors Association, 1730 Rhode Island Ave., N.W., Washington N.W., Washington D.C. 20036.
National Joint Apprenticeship and Training Committee for the Electrical Industry, 1730 Rhode Island Ave., N.W., Washington, D.C. 20036.
Thomas Alva Edison Foundation, Inc., West Orange, N.J. 07052.

GRAPHIC ARTS

Printing Industry of America, Inc., 20 Chevy Chase Circle, N.W., Washington, D.C. 20015.
Professional Photographers of America, Inc., 1090 Executive Way, Oak Leaf Commons, Des Plaines, Ill. 60018, and 151 W. Wisconsin Ave., Milwaukee, Wis. 53203.

METALS

American Astronomical Society, 211 Fitz Randolph Road, Princeton, N.Y. 08540.
American Geological Institue, 1444 N St., N.W., Washington, D.C. 20005.
American Iron and Steel Institute, 150 E. 42nd St., New York, N.Y. 10017.
American Meteorological Society, 45 Beacon St., Boston, Mass. 02108.
American Optometric Association, 4030 Chouteau Ave., St. Louis, Mo. 63110.
American Society of Heating, Refrigerating and Air Conditioning Engineers, Inc., 345 E. 47th St., New York, N.Y. 10017.
American Society of Mechanical Engineers, 345 E. 47th St., New York. N.Y. 10017.
American Welding Society, 345 E. 47th St., New York, N.Y. 10017.
Association of American Geographers, 1146 16th St., N.W., Washington, D.C. 20036.
Forging Industry Association, 55 Public Square, Cleveland, Ohio 44113.
International Association of Machinists. 1300 Connecticut Ave., N.W., Washington, D.C. 20036.
National Association of Manufacturers. Two E. 48th St., New York, N.Y. 10017.
National Coal Association, Educational Director, Washington, D.C. 20036.
National Tool, Die and Precision Machinery Manufacturers Association. 907 Public Square Bldg., Cleveland, Ohio 44113.
Sheet Metal and Air Conditioning Contractors National Association, Inc., 107 Center St., Elgin, Ill. 60120.
United Association of Journeymen, Apprentices, of Plumbing and Pipe Fitting Industries, 901 Massachusetts Ave., N.W., Washington, D.C. 20001.

WOODS/CONSTRUCTION

American Federation of Labor, Congress of Industrial Organization, Building and Construction Trades Dept., 815 16th St., N.W., Washington, D.C. 20006.

American Institute of Interior Designers, 673 Fifth Ave., New York, N.Y. 10022.

Archeology Institute of America, 100 Washington Square East, New York, N.Y. 10003.

Associated General Contractors of America, Inc., 1957 E St., N.W., Washington, D.C. 20006.

Botanical Society of America, Dept. of Botany, Indiana University, Bloomington, Ind. 47405.

Brotherhood of Painters, Decorators and Paperhangers of America, 217-219 N. Sixth St., Lafayette, Ind. 47091.

National Association of Home Builders, 1625 L St., N.W., Washington, D.C. 20036.

National Association of Plumbing, Heating-Cooling Contractors, 1016 20th St., N.W., Washington, D.C. 20036.

National Association of Real Estate Boards, Department of Education, 36 S. Wabash Ave., Chicago, Ill. 60603.

National Paint, Varnish and Lacquer Association, 1500 Rhode Island Ave., N.W., Washington, D.C. 20005.

National Roofing Contractors Association, 300 W. Washington St., Chicago, Ill. 60606.

Society of American Foresters, 1010 16th St., N.W., Washington, D.C. 20006.

Structural Clay Products Institute, 1520 18th St., N.W., Washington, D.C. 20036.

GOVERNMENTAL AGENCIES AND OTHER AGENCIES AND ASSOCIATIONS

American Dental Association, Council on Dental Education, 211 E. Chicago Ave., Chicago, Ill. 60611.

American Institute of Chemical Engineers, 345 E. 47th St., New York, N.Y. 10017.

American Institute of Physics, 335 E. 45th St., New York, N.Y. 10017.

American Mathematical Society, P.O. Box 6248, Providence, R.I. 02904.

American Medical Association, 535 N. Dearborn St., Chicago, Ill. 60610.

American Occupational Therapy Association, 250 W. 57th St., New York, N.Y. 10019.

American Physical Therapy Association, 1790 Broadway, New York, N.Y. 10019.

Chamber of Commerce of the United States, Washington, D.C. 20006.

Manufacturing Chemists Association, Inc., 1825 Connecticut Ave., N.W., Washington, D.C. 20009.

Mathematical Association of America, University of Buffalo, Buffalo, N.Y. 14214.

National Education Association, 1201 16th St., N.W., Washington, D.C. 20036.

National Institute of Ceramic Engineers, 4055 N. High St., Columbus, Ohio 43214.

National Recreation and Parks Association, 1700 Pennsylvania Ave., N.W., Washington, D.C. 20006.

President's Committee on the Employment of the Handicapped, Washington, D.C. 20210.

Retail Jewelers of America, Inc., 1025 Vermont Ave., N.W., Washington, D.C. 20005.

Society of Industrial and Applied Mathematics, 33 S. 17th St., Philadelphia, Pa. 19103.

Smithsonian Institute, Washington, D.C. 20560.

Society of the Plastics Industry, Inc., 250 Park Ave., New York, N.Y. 10017.

Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402.

U.S. Civil Service Commission, Washington, D.C. 02415.

U.S. Department of Agriculture, Washington, D.C. 20250.

U.S. Department of Agriculture, Bureau of the Census, Washington, D.C. 20233.

U.S. Department of Defense, Washington, D.C. 20301: U.S. Air Force 20330; U.S. Army 20310; U.S. Coast Guard 20390; U.S. Marine Corps 20380; and U.S. Navy 20350.

U.S. Department of Health, Education and Welfare, Washington, D.C. 20201: Office of Education, Guidance and Student Personnel Section 20202; and Public Health Service 20203.

U.S. Department of Labor, Washington, D.C. 20210: Bureau of Apprenticeship 20212; Bureau of Labor Statistics 20212; U.S. Employment Service 20211; and Women's Bureau 20210.

Veteran's Administration, Washington, D.C. 20420.

SUGGESTED DRAFTING EQUIPMENT LIST
from
A Guide for Equipping Industrial Arts Facilities*

The quantity recommended is for a class of approximately 24 students.

NO.	ITEM	INTRO.	ADVANCED
I.	AUDIO-VISUAL EQUIPMENT		
1	COMPASS, CHALKBOARD -- 16'' min. length.	x	x
1	DISPLAY BOARD -- 48''x48'' to 96''x96''	x	x
1	DIVIDER BLACKBOARD	x	x
1	PROJECTION BOX, PLASTIC	x	
1	PROJECTION BOX, PLASTIC-INSTRUCTOR'S		x
1	PROJECTION BOX, PLASTIC-STUDENT'S		x
1	PROJECTOR, FILMSTRIP -- (35 mm) and slide (2'' x 2'')	x	x
1	PROJECTOR, MOTION SOUND PICTURE -- 16mm	x	x
1	PROJECTOR, OVERHEAD	x	x
1	PROTRACTOR, CHALKBOARD -- 15''	x	x
1	SCALE, CHALKBOARD (DEMONSTRATION) -- 6' min. length	x	x
1	SCREEN, PROJECTION -- 60''x60''	x	x
1	TRIANGLE, CHALKBOARD 30° - 60° -- 24''	x	x
1	TRIANGLE, CHALKBOARD 45° -- 24''	x	x
II.	INSTRUMENTS AND TOOLS		
24	BRUSH, DUSTER, DRAFTSMAN'S	x	x
24	COMPASS AND DIVIDER (SET) -- 6½''	x	x
4	COMPASS, BEAM -- 24''	x	x
1	COMPASS, DROP BOW -- 4''		x
1	CURVE, IRREGULAR (SET	x	x

*American Industrial Art Association 1967

NO.	ITEM	INTRO.	ADVANCED
1	CURVE, RULE (ADJUSTABLE)		x
1	CUTTER, PAPER -- 24''	x	x
2	DISPENSER, DRAFTING TAPE	x	x
2	DIVIDER, PROPORTIONAL -- 7½'' min.		x
24	ERASER SHIELDS -- 2½'' x 3¾'' x .005T.	x	x
6	FOUNTAIN PEN (TECHNICAL SET) -- sizes 00, 0, 1, 2, 2½, 3, 4,		x
1	GEOMETRIC SHAPES (SET)		x
24	LETTERING GUIDE LINE INSTRUMENT	x	x
1	LETTERING SET -- 11 Templates; 11 pens		x
1	OILSTONE, ARKANSAS -- Wedge-shaped; Fine grain	x	x
1	PANTOGRAPH, DRAFTING -- 21'' Hardwood bars		x
24	PEN HOLDER -- wood or metal - 6'' to 7''		x
24	PEN SET -- crow, flex., hawk quill, mapping; imperial, artist, drawing pens, and holders		x
1	PEN, SPEEDBALL (SET) -- Styles AO-5, BO-6, CO-6, DOO-5		x
24	PENCIL POINTER, LEAD PENCIL	x	x
1	PENCIL POINTER, MECHANICAL	x	x
1	PENCIL SHARPENER, DRAFTSMAN'S	x	x
1	PENCIL SHARPENER, STANDARD	x	x
6	PROTRACTOR, SEMI-CIRCULAR -- 6'' plastic	x	x
1	REPAIR KIT, DRAFTING INSTRUMENT		x
24	SCALE, ARCHITECTS'S -- 12''	x	x
12	SCALE, DECIMAL, CIVIL ENGINEER'S -- 12'' - 10, 20, 30, 40, 50, 60, parts to the inch		x
6	SCALE, MECHANICAL ENGINEER'S -- 12'' - ½'' = 1', 3'' = 1', 4½''-1', 6'' = 1', 9'' = 1', and full size	x	x
1	SCALE, METRIC -- 12''; plastic; Graduations: 1cm., 2cm., 2.5 cm., 3cm., 5cm.		x
1	SCISSORS -- 8''	x	x

NO.	ITEM	INTRO.	ADVANCED
1	SIGN-MAKER SET		x
12	STRAIGHT EDGE, PARALLEL RULING -- Transparent plastic edges		x
12	TEMPLATE, ARCHITECTURAL -- House plan and plumbing - ¼''=1'-0'' 1/8''61'-0''		x
6	TEMPLATE, ELECTRONIC -- NASA Standard		x
6	TEMPLATE, ISOMETRIC CIRCLE -- 38 ellipses; plastic		x
6	TEMPLATE, ISOMETRIC CIRCLE, LARGE -- 25 ellipses; plastic		x
24	TEMPLATE, LARGE CIRCLE -- 36 circles; 24 semi-circles		x
5	TEMPLATE, NUTS AND BOLTS -- Sizes 5''x10 7/16''x.030'' plastic		x
24	TRIANGLE, 30° - 60° (8'')	x	
24	TRIANGLES, 30° - 60° '(10'' and 12'')		x
24	TRIANGLE, 45° (6'')	x	
24	TRIANGLE, 45° (8'')		x
3	TRIANGLE, 45° (12'')		x
6	TRIANLGE, ADJUSTABLE (10'')		x
24	T SQUARES -- Hardwood head and blade; min. size 24''	x	x
III. MACHINES			
1	ERASING, MACHINE, ELEC. -- 110-115V; 2400-3400 RPM		x
8	MACHINE, DRAFTING (18'') -- with 9'' and 18'' scales		x
4	MACHINE, DRAFTING (24'') -- with 12'' and 18'' scales		x
1	MACHINE, REPRODUCTION (DRY TYPE) -- 42'' capacity	x	x
1	MACHINE, REPRODUCTION (MOIST TYPE) -- 42'' capacity	x	x
1	MARKING TOOL, ELECTRIC -- Tantalum carbide point	x	x
IV. GENERAL FURNISHINGS			
24	BOARD, DRAFTING -- 18''x24'' (begin.) 24''x36'' or 31''x42'' (advanced)	x	x
1	BOOKCASE -- 60''H.x10''-12''	x	x
2	BROOM, PUSH	x	x

NO.	ITEM	INTRO.	ADVANCED
12	BRUSH, BENCH -- 2½'' white bristles	x	x
1	CABINET, FILING -- 4 drawer, size 52'' Hx15''Wx28½ D	x	x
2	CABINET STORAGE -- All steel; adj. shelves; 2 door; with lock	x	x
1	CHAIR, TEACHER'S -- Welded steel const.; swivel base w/casters	x	x
1	DESK, TEACHER'S -- Approx size 42'' x 30'' x 29''H; welded steel const.	x	x
1	DESK, TEACHER'S STANDING -- Approx. size 36''x26''x42''H; welded steel const.	x	x
1	FILE, DRAFTING -- flat cap; two 5 drawer units; for 36''x48'' drawing sheets		x
1	FRAME, PRINTING -- Accommodate 17''x22'' drawings		x
1	PAN, DUST -- 12''; steel	x	x
1	RACK, MAGAZINE -- 60''H, 12''D, and 36''1; display type; adj. shelves		x
1	STOOL, INSTRUCTOR's -- Swivel type; 17''x16'' foam rubber seat; H. 28''-34''; 1''tub. steel	x	x
24	STOOL, STUDENT'S ADJUSTABLE -- 14'' sq. seat;	x	x
24	TABLE, DRAFTING -- Approx. size 38''x28''x39''H; metal or wood: star. 6 boards; keyed drawers.	x	x
1	TABLE, OVEHEAD PROJECTOR -- 26''H; portable	x	x
1	TABLE, PLANNING -- 72''x30''x30''H.		x
V.	MISCELLANEOUS		
1	CALIPER, INSIDE (6'') -- solid nut; bow spring		x
1	CALIPER, OUTSIDE (6'') -- solid nut; bow spirng		x
1	DIE, LETTER (SET) -- for hard surfaces; 3/16	x	x
1	DIE NUMBER (SET) -- for hard surfaces; 3/16''	x	x
1	EXTENSION CORD -- Heavy duty; grounded; 25'	x	x
1	FIRE EXTINGUISHER	x	x
1	FIRST AID KIT	x	x

NO.	ITEM	INTRO.	ADVANCED
1	GUAGE, SCREW PITCH -- 22 pitches; from 9-40		x
1	GUAGE, WIRE AND SHEET METAL (AMERICAN)	x	x
1	GUAGE, WIRE AND SHEET METAL (U.S.S.)	x	x
1	HAMMER, CLAW (16 oz.) -- Curved claw; bell faced	x	x
6	KNIFE, CARVING (SET) -- To include three blade holders; #1, 2, 6 knives; etc.		x
1	MICROMETER, OUTSIDE (1'') -- Graduated in .001.		x
1	PLIERS, STRAIGHT NOSE -- 8'' combination	x	x
1	PUNCH, PAPER -- multiple type; 1 to 4 holes	x	x
1	RULE, FLEXIBLE, STEEL TAPE (12') -- 3/4'' wide		x
1	RULE, FLEXIBLE, STEEL TAPE (100') -- 3/4'' wide		x
1	SCREWDRIVER, PHILLIPS (SET) -- Points #1, 2, and 3.	x	x
1	SCREWDRIVER, STANDARD BIT (ROUND BLADE) (SET OF FIVE) -- blade widths 3/16'', ½'', 5/6'', 38'', ½	x	x
1	SCREWDRIVER, STANDARD BIT (SQUARE BLADE) (6)	x	x
1	SQUARE, COMBINATION SET (WITH PROTRACTOR AND CENTER HEAD) -- 12''		x
1	STAPLER, HAND -- 8½''; throat depth 4''	x	x
1	T BEVEL, SLIDING -- 6''; iron handle		x

Missouri
State
Department
of Education

"Change should be appreciated and made welcome, not avoided or resented. As Americans, we've benefited enormously from it. Today, change is rampant and nowhere is it more evident than in the field of education. We can no longer think in traditional terms. Tomorrow and for many years to come, education must recognize the "career" concept which included all areas and all levels of career preparation."

Arthur L. Mallory
Commissioner of Education